

The Palaearctic triozids associated with Rubiaceae (Hemiptera, Psylloidea): a taxonomic re-evaluation of the *Trioza galii* Foerster complex

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The Palaearctic triozids associated with Rubiaceae (Hemiptera, Psylloidea): a taxonomic re-evaluation of the *Trioza galii* Foerster complex.

The Palaearctic *Trioza galii* complex is revised to contain *T. cocquempoti* sp. n., *T. drosopouli* sp. n., *T. galii* Foerster and *T. velutina* Foerster stat. rev., with following new synonymies: *T. rubiae* Baeva and *T. rubicunda* Loginova = *T. galii* and *Trioza distincta* Flor = *T. velutina*, respectively. *T. galii* f. *spinogalii* Šulc and *T. galii* f. *aspinovelutina* Šulc are considered to be of infrasubspecific rank and thus unavailable. *Trioza velutina* var. *thoracica* Flor is an available name regarded as nomen dubium. Lectotypes are designated for *Trioza galii* and *T. velutina*. Adults and last instar larvae (except *T. velutina*) are diagnosed and illustrated. Identification keys are provided. All four species are associated with Rubiaceae on which they induce galls. Confirmed hosts of *T. galii* are *Galium* spp. and *Asperula cynanchica*, literature records also suggest *Sherardia arvensis* and *Rubia* spp. *T. cocquempoti* and *T. drosopouli* develop on *Rubia* spp. *T. velutina* is probably associated with *Galium* spp. but hard evidence is not available. The *T. galii* complex is diagnosed using adult and larval characters. The definition is similar to Conci's (1992) concept of *Spanioza* but excludes *S. tamaninii*. *S. tamaninii* is morphologically intermediate between the *T. galii* complex and the *T. centranthi* complex (associated with Valerianaceae) which may be sister groups. The synonymy of *Spanioza* with *Trioza* is confirmed, and the new combination *Trioza tamaninii* is proposed.

Keywords: Hemiptera - Psylloidea - Triozidae - taxonomy - new taxa - Rubiaceae - Palaearctic.

INTRODUCTION

Species of jumping plant-lice are generally well-defined by their adult and larval morphology as well as their host plants. In particular, the male terminalia are routinely used for species identification. The Palaearctic *Trioza galii* Foerster, as

currently perceived, is a notable exception as the male genital morphology exceeds the usual variability encountered in other *Trioza* species.

Foerster (1848) described both *T. galii* and *T. velutina* from German and Irish localities; some material of *T. galii* was collected on *Galium verum*. The descriptions contain colour and forewing characters but are not diagnostic. Hardy (1853) recorded deformations on *Galium aparine* which he attributed to "*Psylla*" *velutina*. He said that *velutina* appears not to differ from "*Psylla*" *galii*. Flor (1861a), providing detailed descriptions and diagnoses, treated *T. galii* and *T. velutina* as distinct species, pointing out differences in the male paramere. He also assigned a single female specimen from Southern France with a lighter thorax and clear forewing colour, to the variety *Trioza velutina* var. *thoracica*. Again on the basis of a single female, he described *Trioza distincta* from Thuringia, differing from *T. velutina* in the slightly different forewing shape (Flor, 1861b). Flor's more restricted species concept was confirmed by Löw (1882) who examined some of Foerster's and Flor's types. Lethierry (1874), Oshanin (1907) and Aulmann (1913) followed Löw, whereas Scott (1876) and Edwards (1896) adopted Hardy's view, treating *T. galii* and *velutina* as synonyms. Šulc (1913) pointed out that his earlier description (Šulc, 1910) of *T. galii* corresponded with the types of *T. velutina* and having examined types of *T. galii*, *T. velutina* and *T. distincta*, plus other material, reached the same conclusion as Hardy (1853). Thus, he treated *T. velutina*, *T. distincta* and questionably var. *thoracica*, the type of which appears to be lost, as synonyms of *T. galii*. Based on presence or absence of surface spinules as well as colour and shape of the forewing, he defined four forms: *galii* forma typica, f. *spinogalii* Šulc, f. *velutina* and f. *aspinovelutina* Šulc. Boselli (1930) found many specimens in Italy on *Rubia peregrina* which he referred to *Spanioza galii aspinovelutina*. He gave detailed descriptions and illustrations of the adults, larvae and eggs and provided information on their biology. The male paramere of Boselli's material, however, is more massive than those described and illustrated by Šulc (1910, 1913). *T. galii*, in this broad definition, has been reported from all over the Palaearctic, including Japan and Taiwan (Aulmann, 1913; Klimaszewski, 1973; Gegechkori & Loginova, 1990; Ossiannilsson, 1992). According to these authors, the species is associated with *Galium*, *Sherardia* and *Rubia* spp. (Rubiaceae), where it induces characteristic deformations on the buds, shoots and leaves, which can be above or below ground (e.g. Houard, 1909; Docters van Leeuwen, 1937).

Adults are regularly encountered by sweeping herbaceous vegetation, although rarely on the host plants. Larval material, by contrast, is generally difficult to find. The first larval description referred to *T. galii* is by Kieffer (1889) who examined material from *Sherardia arvensis* but his description is not diagnostic. The dorsum of the larva is said to be dark brown. A more detailed larval description referred to *T. galii* is that by Boselli (1930). White & Hodkinson (1981) used Boselli's description in their handbook of the British species, and Ossiannilsson (1992) in the Fauna Scandinavica described Italian rather than Scandinavian specimens.

Three additional Palaearctic species are reported from Rubiaceae. Baeva (1972) described *Trioza rubiae* from Turkmenia based on a single series collected on *Rubia florida*, which she related to *Trioza foersteri* Meyer-Dür and *Trioza rotundata* Flor. Loginova (1978) added *Trioza rubicunda*, again based on a single series, collected in

Kazakhstan on *Galium* sp. According to Loginova *T. rubicunda* is closest to *T. galii* f. *velutina* from which it differs in the reduced surface spinules and a broader paramere. *T. rubiae* and *T. rubicunda* have not been subsequently reported. Conci (1992) described *Spanioza tamaninii* from Italian and Slovakian specimens, one of which was collected on *Galium anisophyllum*. He suggested that *S. tamaninii* is closely related to *galii* and that its host may be *Galium*.

Trioza galii was selected by Enderlein (1926) as type species of *Spanioza*, a genus which he erected for triozids with a short Rs vein in the forewing. The artificial nature of this concept was pointed out by Tuthill (1943) who synonymised it with *Trioza*. Conci (1992) considered *Spanioza* a valid genus and redefined it to include *Trioza galii* and its "formae", *Trioza rubiae* Baeva, *Trioza rubicunda* Loginova and *Spanioza tamaninii* Conci. This was not followed by Burckhardt & Couturier (1994) who treated the *Trioza galii* group as part of the large artificial genus *Trioza*.

Over the last few years collections from the Mediterranean as well as Central and Western Europe yielded material including larvae and host records which permit a re-evaluation of the taxonomy of the *Trioza galii* complex. Wagner & Franz (1961) suggested that *T. galii* in the broad definition by Šulc (1913) is a species complex, and Conci (1992) wrote that *Trioza galii* and its "formae" require revision. The present paper provides this revision and re-examines the validity of *Spanioza*.

MATERIAL AND METHODS

Material has been examined or is mentioned from following institutions:

BMNH	Natural History Museum, London
DEZA	Dipartimento di Entomologia e Zoologia Agraria dell'Università, Portici
EAUT	Institute of Zoology and Botany, Estonian Agricultural University, Tartu
MHNG	Muséum d'histoire naturelle, Geneva
MMBC	Moravské Muzeum, Brno
MNHN	Muséum national d'histoire naturelle, Paris
NHMB	Naturhistorisches Museum, Basel
NHNV	Naturhistorisches Museum, Vienna
SMTD	Staatliches Museum für Tierkunde, Dresden
ZISP	Zoological Institute, St. Petersburg
ZMHB	Museum für Naturkunde der Humboldt-Universität, Berlin
ZSSM	Zoologische Staatssammlung, Munich.

The morphological terminology mainly follows Ossiannilsson (1992). Drawings were prepared from cleared specimens mounted permanently in Euparal or Canada Balsam or temporarily in glycerine. Measurements were taken from slide mounted specimens, except for the total body length which is taken from dry mounted specimens measured from the apex of head to the apex of forewing when folded over the body.

RESULTS

The *Trioza galii* Foerster, 1848 species complex

DESCRIPTION

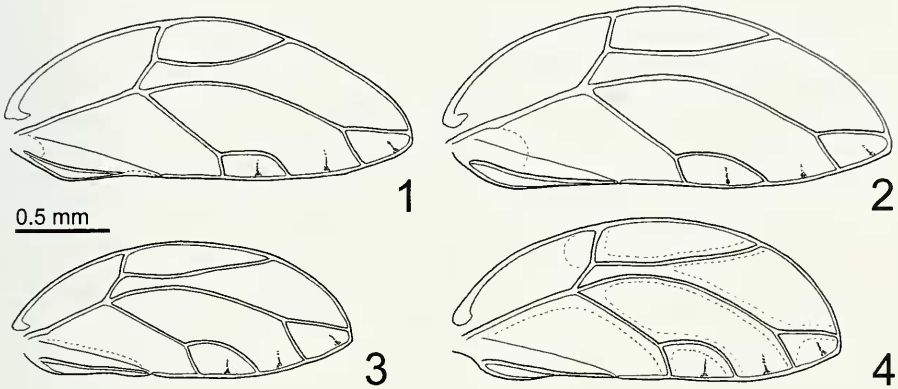
Adult. Coloration mostly dark brown to black, in *T. cocquempoti* and *T. drosopouli* thorax yellowish, brown or dark dorsally, sometimes with longitudinal

stripes; area around wing insertion yellowish or brown; intersegmental membranes reddish; antennal segment 3, tibiae and tarsi whitish. Forewing almost colourless or with yellowish or light brown tinge; veins yellowish or light brown, vein C+Sc often brown or dark brown in basal part. Young specimens lighter.

Head slightly narrower than mesonotum, weakly inclined from longitudinal body axis, at a 45° angle. Vertex shiny, weakly produced anteriorly on either side of mid-line. Genal processes variable in size and shape, conical, subacute, ranging from one to two thirds vertex length. Antenna 10-segmented, segment 3 longer than segments 4 and 5 together; segment 10 bearing one long and one very short terminal seta respectively (Fig. 21). Clypeus short, pyriform. Thorax weakly curved dorsally. Metacoxa with horn-shaped, subacute meracanthus; metatibia weakly widened basally and apically, with some minute basal spines and 1+3 sclerotised apical spurs; metabasitarsus without sclerotised spurs. Forewing (Figs 1-4) transparent, variable in size, shape and colour, elongate, strongly pointed, angular or bluntly angular apically; vein Rs short, bifurcation of vein M slightly or strongly distal to line linking apices of veins Rs and Cu_{1a}. Wing membrane transparent; apart from wing base usually lacking surface spinules, with the exception of *T. velutina* where spinules are always present, forming more or less extended fields. Radular spinules forming narrow stripes in cells m₁, m₂, and cu₁. Hindwing membranous, about two thirds forewing length. Costal setae ungrouped; R+M+Cu₁ indistinctly trifurcating. Abdominal tergite 3 (and occasionally 4) in male and tergite 4 (and occasionally 5) in female bearing a row of lateral setae. Male proctiger (Figs 5, 8, 11, 16) 1-segmented, weakly produced or lobed posteriorly, covered in moderately long setae apically and posteriorly. Subgenital plate subglobular, with a few long setae laterally and ventrally. Paramere (Figs 6, 9, 12, 13, 17) shorter than proctiger, massive or lamellar; sparsely covered in long setae on outer face apically and along hind margin; inner face covered in long thin setae mainly basally, apically and along hind margin, with a group of shorter, stout setae along fore margin in basal half. Proximal portion of aedeagus strongly curved at base, almost straight apically; distal portion (Figs 7, 10, 14, 15, 18) relatively short with large apical dilatation which varies from almost rectangular to distinctly hooked. Sclerotised end tube of ductus ejaculatorius short, weakly curved. Female proctiger (Figs 23-26) short with relatively large circumanal ring. Subgenital plate short.

Fifth instar larva (Fig. 28). Coloration varying from uniformly yellow or light ochreous to yellow with more or less extended pattern on head, thorax, wing buds and abdomen to completely dark. Body oval, bearing a single row of densely spaced, lateral truncate sectasetae. Antenna 6-segmented. Head broadly rounded anteriorly. Legs with short claws and small, fan-shaped tarsal arolium. Humeral lobes blunt, relatively short. Circumanal ring small, with a single row of pores. Dorsum of body lacking macroscopic setosity. Tarsal arolium transversely oval, lacking pedicel, with unguitractor (Figs 29-31). Claws relatively small.

Egg. Spindle-shaped, longer than three times its width, with short basal pedicel and no apical filament. The egg is laid perpendicularly on the leaf margins.



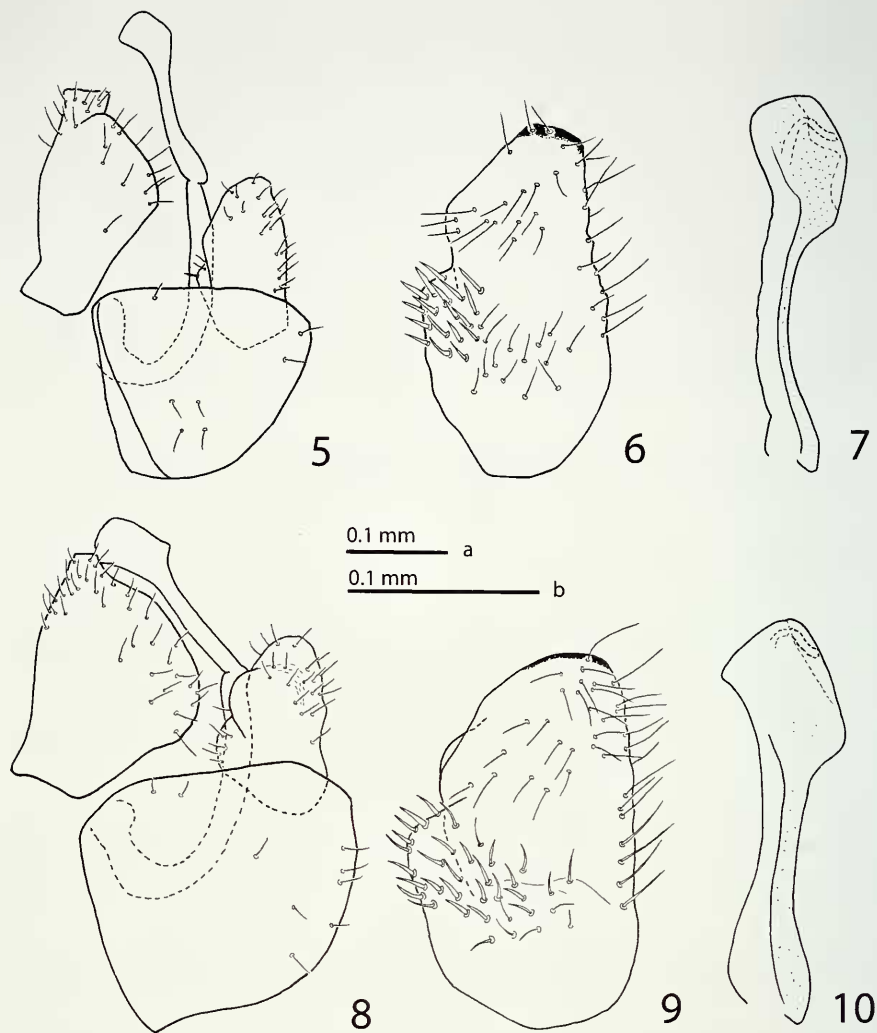
FIGS 1-4

Forewing of *Trioza* spp. 1 – *T. cocquempoti*; 2 – *T. drosopouli*; 3 – *T. galii*; 4 – *T. velutina*.

DISCUSSION

The *T. galii* complex, as defined above, constitutes a small, probably monophyletic group within the large artificial genus *Trioza*. It is restricted to the Palaearctic. It may be most closely related to the *T. centranthi* complex (*T. centranthi* (Vallot), *Trioza nana* Gegechkori and *T. valerianae* Gegechkori), associated with Valerianaceae. Adult *T. galii* and *T. velutina* resemble *T. centranthi* (Vallot) in morphology, size and colour. The distribution of surface spinules on the forewing is variable in *T. centranthi*. They may form relatively extended fields in all cells except for c+sc or they may be restricted to cell cu₂. In *T. centranthi* vein Rs of the forewing tends to be relatively long and sinuous, and the bifurcation of vein M lies near the line joining the apices of veins Rs and Cu_{1a}; in *T. galii* and *T. velutina* in contrast vein Rs is shorter and almost straight or concave; the bifurcation of vein M is more distant to the line joining the apices of veins Rs and Cu_{1a}. *T. centranthi* bears terminal setae on antennal segment 10, with the shorter seta about half as long as the longer one (Fig. 22), in the *T. galii* complex the shorter seta is only about a quarter to a third as long as the longer (Fig. 21). The *T. centranthi* complex is characterised by the irregularly triangular paramere, which sometimes bears a large antero-apical lobe (absent in the *T. galii* complex), and by the apical dilatation of the distal portion of the aedeagus, which bears small lateral spines (*T. centranthi*, Fig. 20) (absent in the *T. galii* complex, Figs 7, 10, 14, 15, 18). The female subgenital plate of *T. centranthi* (Fig. 27) has, on either side, a group of long setae near the dorsal margin, which are longer than the other hairs (hairs laterally, ventrally and terminally are of about the same length in the *T. galii* complex, Figs 23-26).

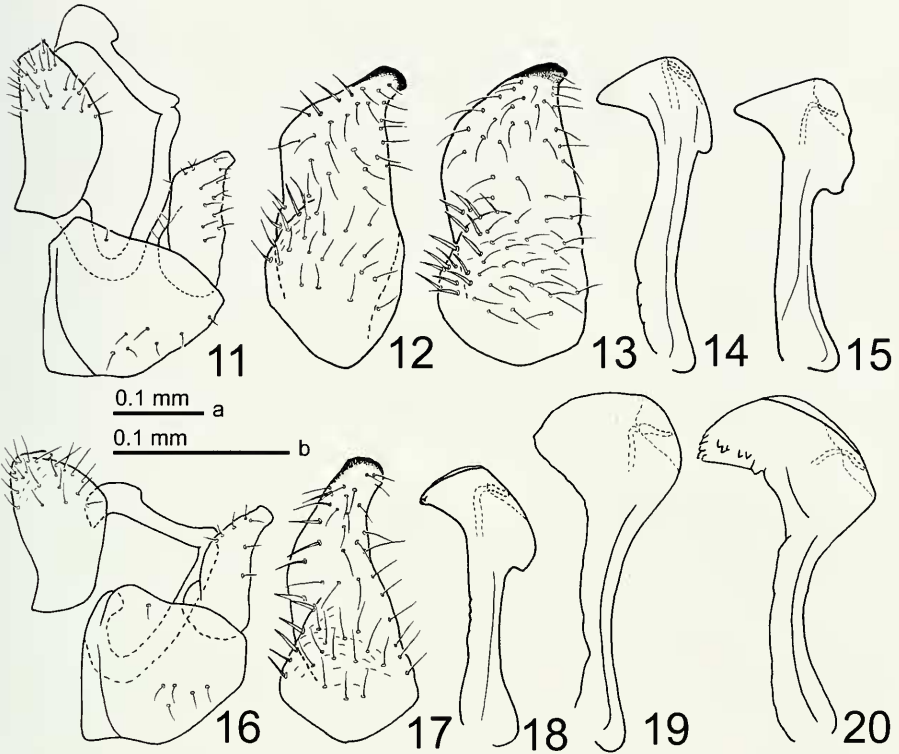
The present concept of the *T. galii* complex differs in two major details from that of Conci (1992). In addition to *T. galii*, *T. rubiae* and *T. rubicunda*, Conci included *Spanioza tamaninii* in the group. *S. tamaninii* has so far been recorded from a few specimens from Italy and Slovakia only. It differs from the *T. galii* complex and the *T. centranthi* complex in having antennae which have light segments 3-8 rather than dark segments with a strongly contrasting light segment 3. The paramere shape, the termi-



FIGS 5-10

Male genital structures of *Trioza* spp. 5-7 - *T. cocquempoti*; 8-10 - *T. drosopouli*. 5, 8 - Terminalia, in profile, scale a; 6, 9 - paramere, inner surface, scale b; 7, 10 - distal portion of aedeagus, scale b.

nal antennal setae and probably also the lateral setosity on the female subgenital plate are as in species of the *T. centranthi* complex. Apart from the antennal colour *S. tamaninii* differs from the *T. centranthi* complex in the apex of the aedeagus (Fig. 19) lacking lateral spines (cf. Fig. 20 for *T. centranthi*). Incidentally Conci's drawing of the aedeagus appears to be artefactual. Larval material is necessary to determine the phylogenetic relationship of *S. tamaninii*.



FIGS 11-20

Male genital structures of *Trioza* spp. 11-15 – *T. galii*; 16-18 – *T. velutina*; 19 – *T. tamaninii*; 20 – *T. centranthi*. 11, 16 – Terminalia, in profile, scale a; 12, 13, 17 – paramere, inner surface, scale b; 14, 15, 18-20 – distal portion of aedeagus, scale b.

Conci (1992) resurrected the genus *Spanioza* for the *T. galii* complex and *S. tamaninii*. He neither provided convincing autapomorphies for *Spanioza* nor did he define a sister group. This makes his *Spanioza* highly artificial and without phylogenetic significance. We follow Burckhardt & Couturier (1994) who treated *Spanioza* as a synonym of *Trioza*. Here we formally transfer *Spanioza tamaninii* to *Trioza* as *T. tamaninii* (Conci) comb. n.

TAXONOMIC TREATMENT

Key for the identification of the species of the *Trioza galii* complex

Adults

- 1 Antenna longer than 1.1 mm. Male proctiger strongly produced posteriorly (Figs 5, 8). Paramere (Figs 6, 9) massive, blunt apically. Apex of distal portion of aedeagus subrectangular or reniform (Figs 7, 10). Ventral and posterior margin of female subgenital plate, in profile (in cleared specimens), forming an angle > 90° (Figs 23, 24) 2

- Antenna shorter than 1.1 mm. Male proctiger tubular, weakly produced posteriorly (Figs 11, 16). Paramere (Figs 12, 13, 17) slender, with apical digitiform process. Apex of distal portion of aedeagus hooked (Figs 14, 15, 18). Ventral and posterior margin of female subgenital plate, in profile (in cleared specimens), forming an angle < 90° (Figs 25, 26) 3
- 2 Male proctiger with narrow posterior lobe (Fig. 5). Paramere (Fig. 6), in profile, with narrow angular bulge above the middle along the fore margin; apex angular. Distal portion of aedeagus (Fig. 7) with reniform apical dilatation. Female terminalia as in Fig. 23. Algeria, France, Italy, Morocco, Spain *T. cocquempoti* sp. n.
- Male proctiger with large posterior lobe (Fig. 8). Paramere (Fig. 9), in profile, with broad bulge in apical third along the fore margin; apex broadly rounded. Distal portion of aedeagus (Fig. 10) with subrectangular apical dilatation. Female terminalia as in Fig. 24. Greece *T. drosopouli* sp. n.
- 3 Forewing (Fig. 3) membrane lacking surface spinules except for base of cell cu₂. Paramere robust, fore margin irregularly curved in apical half (Figs 12, 13). Apex of distal portion of aedeagus with large apical hook (Figs 14, 15). Female proctiger with relatively long and slender apical process, subgenital plate, in profile, truncate apically (Fig. 25) *T. galii*
- Forewing (Fig. 4) membrane with surface spinules present in all cells forming more or less extended fields. Paramere slender, evenly curved (Fig. 17). Apex of distal portion of aedeagus with relatively short apical hook (Fig. 18). Female proctiger with relatively short massive apical process, subgenital plate, in profile, bearing a small point apically (Fig. 26) *T. velutina*

Fifth instar larvae

(larvae of *T. velutina* unknown)

- 1 Body dimensions small, body length < 1.8 mm, see also table 2 *T. galii*
- Body dimensions large, body length > 1.8 mm, see also table 2 2
- 2 Marginal sectasetae on forewing pads over 100, and on hindwing pads over 15. West Mediterranean *T. cocquempoti* sp. n.
- Marginal sectasetae on forewing pads less than 100, and on hindwing pads less than 15. Greece *T. drosopouli* sp. n.

***Trioza cocquempoti* sp. n.**

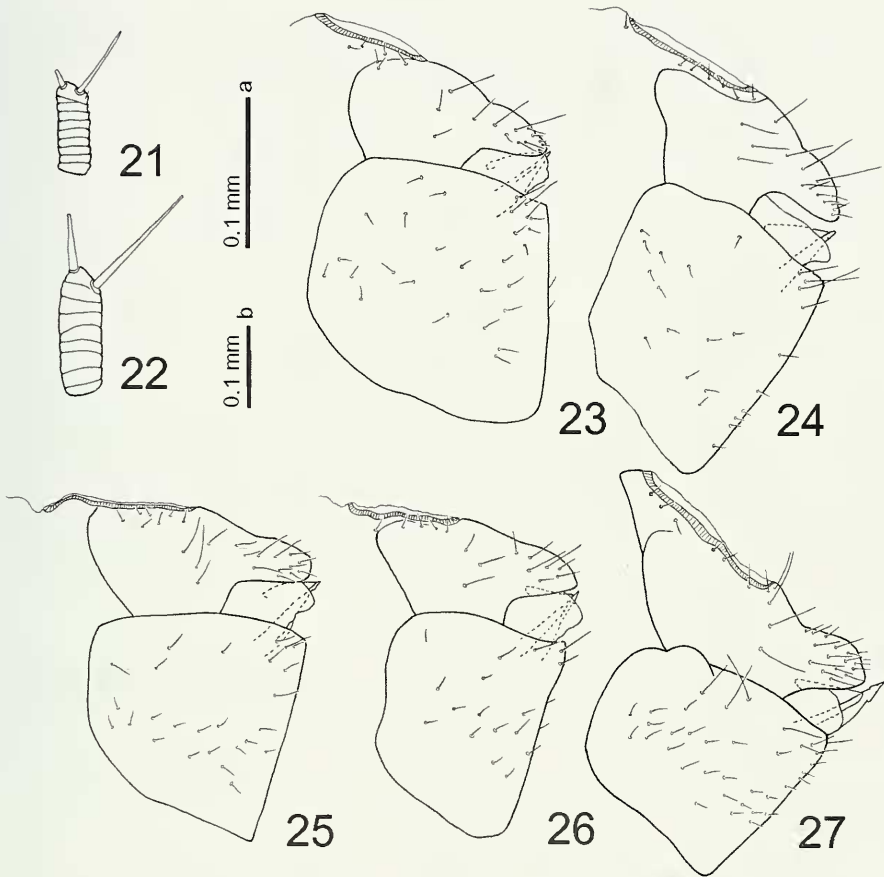
Figs 1, 5-7, 23, 29

Spanioza galii aspinovelutina sensu Boselli, 1930: 14, nec Šulc, 1913.

Trioza galii sensu White & Hodkinson, 1982: 43, nec Foerster, 1848.

MATERIAL EXAMINED: Holotype ♂, **France**: Gard, 5 km W Pont-St.-Esprit, 22.x.1988, *Galium* sp. (D. Burckhardt) (MHNG, dry mounted).

Paratypes. **Algeria**: 1 ♀, Atlas of Blida Chr ea, Les Glaci eres, 1100 m, 3.v.1988 (D. Burckhardt) (MHNG, dry mounted); 1 ♀, Grande Kabylie, Oued Isser, bridge N24, 21.v.1988 (D. Burckhardt) (MHNG, dry mounted). - **France**: 2 ♀, Corsica, Luri, Col de Sainte Lucie, 24.iv.1992 (W. Della Giustina) (NHMB, dry mounted); 1 ♀, Gard, same data as holotype; 1 ♂, 1 ♀, Var, Roquebrune-sur-Argens, Les Sauterons, 15-20.iv.1990 (C. Lienhard) (NHMB, dry mounted); 1 ♂, 2 ♀, Indre et Loire, La Roche-Clermaut, Malaise trap, 11.viii.1989 (C.



FIGS 21-27

Trioza spp. 21, 25 – *T. galii*; 22, 27 – *T. centranthi*; 23 – *T. cocquempoti*; 24 – *T. drosopouli*; 26 – *T. velutina*. 21, 22 – Antennal segment 10, scale a; 23-27 – female terminalia, in profile, scale b.

Cocquempot) (MMBC, dry mounted and stored in glycerine); 1 ♂, Indre et Loire, Roquebrunnesur-Argens, 15-20.iv.1990 (C. Cocquempot) (MMBC, stored in glycerine); 2 ♀, Tarn, Albi, Fargues, 30.v.1933, *Crataegus* (A. Perrier) (MNHN, dry mounted); 1 ♀, Tarn, Albi, 7.vi., *Crataegus* (A. Perrier) (MNHN, dry mounted); 1 ♀, Albi, Castelnau-de-Lévi, 8.iv., *Rhus* (A. Perrier) (MNHN, dry mounted); 1 ♀, Albi, Creyssence, 14.vi., *Buxus* (A. Perrier) (MNHN, dry mounted); 1 ♂, Vaucluse, La Roque-Alric, near Beaumes-de-Venise, 300 m, 23.iv.1984 (C. Lienhard) (MHNG, slide mounted); 2 ♂, Vaucluse, near Vacqueyraz, river Ouvèze, 60 m, 26.iv.1984 (C. Lienhard) (MHNG, dry mounted); 6 ♂, 7 ♀, without locality data (MNHN, dry mounted). - **Italy**: 1 ♂, 5 ♀, 2 parasitised larvae, Portici, 25.v.1928, *Rubia* (F. B. Boselli) (DEZA, dry mounted); ca. 100 larvae and exuviae, 21.v.1928, *Rubia* (F. B. Boselli) (DEZA, alcohol); 10 ♂, 9 ♀, 45 larvae and exuviae, Portici, Parco Gussone, v-vi.2004 (P. A. Pedata) (DEZA, alcohol; NHMB, slide mounted); 1 ♂, Basilicata, Potenza, PR Gallipoli Cognato, near Monte Crocchia, 810-910 m, 1-4.v.2001, Malaise trap 2 (Springate *et al.*) (DEZA, alcohol); 1 ♂, Basilicata, Matera, PR Gravina di Matera, 15 km E of Masseria San Francesco, 16-19.iii.2002,

290-310 m, Malaise trap (Springate *et al.*) (DEZA, alcohol); 2 ♀, same but 27-30.iv.2001, 290-370 m; 2 ♂, 2 ♀, same but PR Gravina di Matera, 2.5 km W of road to Ginosa, 28-30.iv.2001; 1 ♀, same but PR Gravina di Matera, 1.5 km W of road to Ginosa, 25-28.ix.2001; 1 ♂, Campania, Napoli, Parco Gussone, 55 m, 1-4.iv.2002, Malaise trap (Springate *et al.*) (DEZA, MMBC, NHMB, alcohol, dry mounted); 2 ♂, 4 ♀, same but 55-80 m, 17-20.v.2001; 3 ♀, same but Caserta, WWF San Silvestro, 270-300 m, 13-16.v. 2001. - **Morocco**: 1 ♀ without wings, Tanger (MMBC, Šulc collection). - **Spain**: 1 ♂, Zaragoza Province, Monegros Region, Pina de Ebro, 360 m, 2.vi.1990 (J. Blasco-Zumeta) (MHNG, dry mounted).

Material excluded from type series. **France**: 1 adult without abdomen, Vaucluse, La Roque-Alric, 350 m, 27.iv.1984 (C. Lienhard) (MHNG, dry mounted).

DIAGNOSIS: Adult. Total body length 2.8-3.3 mm. Colour of thorax yellow, sometimes brown or dark brown dorsally, or with brown longitudinal stripes on mesopraescutum and mesoscutum. Genal processes 0.6 times as long as vertex along midline, subacute apically. Forewing (Fig. 1) elongate, pointed apically; bifurcation of vein M distinctly distal to line connecting apices of veins Rs and Cu_{1a}. Forewing membrane lacking surface spinules except at wing base. Hindwing two thirds of forewing length. Male proctiger (Fig. 5) relatively massive, strongly produced posteriorly. Paramere (Fig. 6) massive, truncate apically, in profile, with narrow angular bulge in apical third along the fore margin; apex angular. Distal portion of aedeagus (Fig. 7) with reniform apical dilatation. Female proctiger (Fig. 23) relatively short, pointed apically; ventral and posterior margin of female subgenital plate, in profile (in cleared specimens), forming an angle > 90°. Measurements as in Table 1.

Fifth instar larva described by Boselli (1930) as *Spanioza galii aspinovelutina*. With following numbers of marginal setae (one side only): head 42-46, forewing pad 109-113, hindwing pad 15-18, caudal plate 108-122. Tarsal arolium transversely oval (Fig. 29). Measurements as in Table 2.

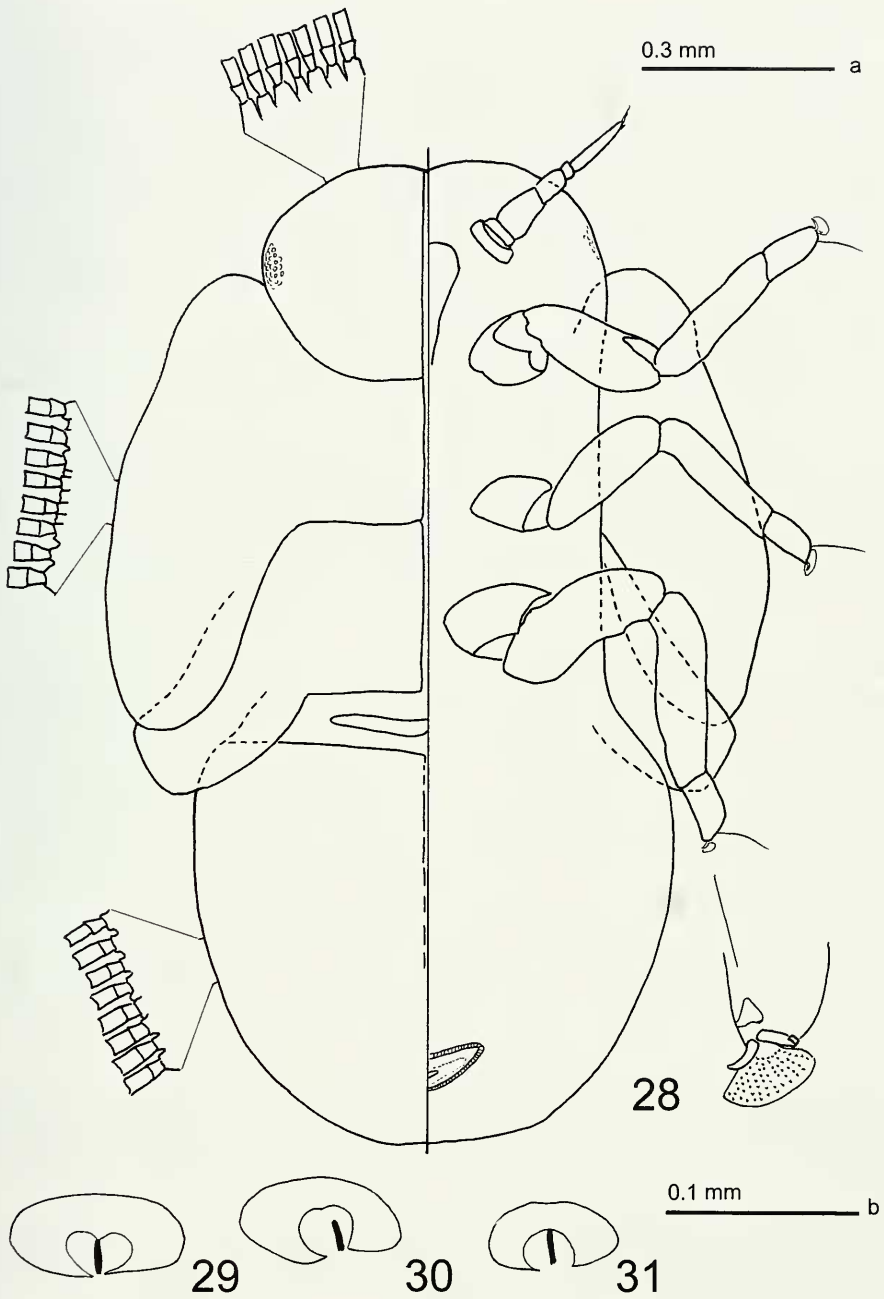
ETYMOLOGY: The species is dedicated to Christian Cocquempot, one of the collectors of the new species.

DISTRIBUTION: Algeria, France, Italy, Morocco, Spain.

BIOLOGY. Host plant. Boselli (1930) collected eggs, larvae and adults exclusively on *Rubia peregrina*. The larvae induce a strong curling of the leaves. Boselli could not find any specimens on *Galium*. The holotype ♂ and a female paratype from France have been taken on *Galium* sp. but no larvae were found. At the moment there is no evidence that *Galium* is a host plant.

According to Boselli (1930) larvae of *T. cocquempoti* aestivate and hibernate in the galls on the host, which also has a summer and winter dormancy. In spring and autumn when the host produces new flush, the adults emerge and, a few days later after copulation, the females lay their eggs. The eggs are laid perpendicularly on the leaf margins or stems. Depending on the season the egg development takes two (spring generation) to over four weeks (autumn generation). If the conditions in spring are particularly favorable, three generations per year are possible.

COMMENTS: The description of *Spanioza galii aspinovelutina* by Boselli (1930) concerns *T. cocquempoti*, which was also confirmed by the examination of Boselli's material. For the validity of the name *aspinovelutina* see comments to *T. galii*. The larval description by White & Hodkinson (1982), tentatively referred to *T. galii*, is based on Boselli's (1930) description and, hence, refers to *T. cocquempoti*.



FIGS 28-31

Trioza spp. 28, 31 – *T. galii*; 29 – *T. cocquempoti*; 30 – *T. drosopouli*. 28 – Last instar larva, left dorsal face, right ventral face (scale a), with details of marginal setae and tarsal apex (scale b); 29-31 – tarsal arolium, scale b.

Trioza drosopouli sp. n.

Figs 2, 8-10, 24, 30

MATERIAL EXAMINED: Holotype ♂, **Greece**: Attiki, Tatoi, NW Athens, 250 m, 1.v.1995, *Rubia tinctorum* (P. Lauterer) (NHMB, dry mounted).

Paratypes. **Greece**: 16 ♂, 43 ♀, 1 exuvia, Attiki, same data as holotype (MMBC, 14 ♂, 38 ♀ dry mounted, 1 ♂, 2 ♀, 1 exuvia, stored in glycerine; NHMB, 2 ♀♀ dry mounted, 1 ♂, 1 ♀ stored in glycerine); 4 ♂, 12 ♀, same data but 200 m, 7.v.1995, clearing and *Pinus* wood (MMBC, 3 ♂, 11 ♀ dry mounted; NHMB, 1 ♂, slide mounted, 1 ♀ dry mounted); 2 ♂, 3 ♀, Attiki, Paríntha Mountains, Agía Trías Parínthos, 1200 m, 28.v.1995, *Rubia tinctorum* in wood undergrowth (P. Lauterer) (MMBC, 1 ♂, 2 ♀ dry mounted; NHMB, 1 ♂, 1 ♀ dry mounted); 1 ♀, Akarnanía, Gavrolimni, 120 m, 17.iii.1982 (C. Lienhard) (MHNG, dry mounted); 1 ♀, Arkadia, E Peloponnissos, 4 km E of Agios Petros, 900 m, 5.v.1995 (P. Lauterer) (MMBC, dry mounted); 1 exuvia, Messinía, Messene, between Kalamata and Pilos, 16.v.1979 (D. Burckhardt) (MHNG, slide mounted).

Material not included in type series. **Greece**: 1 ♂, 11 ♀, damaged, Attiki, same data as holotype (MMBC); 1 very teneral ♀, Messinía, Messene, between Kalamata and Pilos, 16.v.1979 (D. Burckhardt) (MHNG, slide mounted).

DIAGNOSIS: Adult. Total body length 2.8-3.4 mm. Colour of thorax yellow or ochreous; mesopraescutum dark brown or black, sometimes with a median longitudinal lighter stripe; mesoscutum ochreous to light brown, sometimes with dark brown longitudinal stripes, generally lighter than mesopraescutum. Genal processes 0.8 times as long as vertex along mid-line, subacute apically. Forewing (Fig. 2) elongate, pointed apically; bifurcation of vein M distinctly distal to line connecting apices of veins Rs and Cu_{1a}. Forewing membrane lacking surface spinules except at wing base. Hindwing two thirds of forewing length. Male proctiger (Fig. 8) massive, strongly produced posteriorly. Paramere (Fig. 9) massive, blunt apically, in profile, with large angular bulge in apical third along the fore margin; apex rounded. Distal portion of aedeagus (Fig. 10) with angular apical dilatation. Female proctiger (Fig. 24) relatively short, pointed apically; ventral and posterior margin of female subgenital plate, in profile (in cleared specimens), forming an angle > 90°. Measurements as in Table 1.

Fifth instar larva. With following numbers of marginal sectasetae (one side only): head 39-44, forewing pad 94-99, hindwing pad 11-12, caudal plate 97-110. Tarsal arolium oval (Fig. 30). Measurements as in Table 2.

ETYMOLOGY: The species is dedicated to our friend Sakis Drosopoulos who organised the collecting trip of Pavel Lauterer to Greece and assisted in the field.

DISTRIBUTION: Greece (Akarnanía, Arkadia, Attiki, Messinía).

BIOLOGY: A larval skin and adults, including teneral specimens, have been collected on *Rubia tinctorum* which is a likely host. A few teneral adults were collected on 1 May and followed by mature adults up to 28 May, suggesting that the bionomics may be similar to that of *T. cocquempoti*.

COMMENTS: No reliable characters could be found for separating the females of *T. drosopouli* and *T. cocquempoti*.

Trioza galii Foerster

Figs 3, 11-15, 21, 25, 28, 31

Trioza galii Foerster, 1848: 87; Šulc, 1913: 38, p. p. Lectotype ♂, **Germany**: Nordrhein-Westfalen, near Aachen (A. Foerster) (MMBC), here designated, examined.

Psylla galii: Hardy, 1853: 3876.

Trioza galii Foerster f. *aspinovelutina* Šulc, 1913: 44. Name unavailable, articles 45.6.1 and 45.6.4, ICZN, 1999.

Spanioza galii; Enderlein, 1926: 400; Conci, 1992: 258.

Trioza rubiae Baeva, 1972: 63. Holotype ♂, **Turkmenistan**: north-western part of Turkmen-Khorasan Mountains, around Yaradzha, 21.iv.1971, *Rubia florida* (V. Baeva, O. Rudenko) (ZISP, dry mounted), examined. **Syn. n.**

Trioza rubicunda Loginova, 1978: 111. Holotype ♂, **Kazakhstan**: Chimkent District, Aksu-Dzhibagly Reservation, Talass Mountain Range, 80 km E Chimkent, 10.vi.1966, *Galium* sp., (M. M. Loginova) (ZISP, dry mounted), examined. **Syn. n.**

Spanioza rubiae; Conci, 1992: 258.

Spanioza rubicunda; Conci, 1992: 258.

MATERIAL EXAMINED: Material was examined from following countries: Algeria; Armenia; Austria: Oberösterreich, Steiermark; Bulgaria; Czech Republic, Bohemia, Moravia; Cyprus; France: Finistère, Haute-Garonne, Hautes-Pyrénées, Hérault, Indre et Loire, Landes, Maine-et-Loire, Nord, Pas-de-Calais, Tarn, Var; Germany: Baden-Württemberg, Berlin, Brandenburg, Hessen (including paralectotype ♂, Ems, leg. C.H.G. von Heyden), Nordrhein-Westfalen (including ♂ lectotype and paralectotypes 6 ♂ and 1 adult without abdomen, Aachen), Sachsen; Greece: Atikí, Corfu, Crete, Cyclades, Évia; Israel; Italy: Alto Adige, Puglia; Jordan; Kazakhstan (including ♂ holotype of *Trioza rubicunda*); Kyrgyzstan; Malta; Slovakia; Slovenia; Spain: Caceres, Zaragoza, Canaries; Switzerland: Aargau, Basel-Land, Genève, Luzern, Neuchâtel, Vaud, Valais; Turkey: Aydin; Tunisia; Turkmenistan (including ♂ holotype of *Trioza rubiae*); United Kingdom: England, Scotland, Wales (BMNH, MHNG, MMBC, MNHN, NHMB, NHMV, SMTD, ZISP, ZMHB, ZSSM).

DIAGNOSIS: Adult. Total body length 2.3-3.2 mm. Colour of thorax usually dark brown or almost black with exception of area around wing insertion which is yellowish. Younger specimens with light colour more expanded and dark areas brown rather than black. Genal processes 0.3-0.7 times as long as vertex along mid-line, blunt to subacute apically. Forewing (Fig. 3) varying from relatively short and wide to elongate, angular apically; bifurcation of vein M on or slightly distal to line connecting apices of veins Rs and Cu_{1a}. Forewing membrane lacking surface spinules except at wing base. Hindwing three quarters or four fifth of forewing length. Male proctiger (Fig. 11) relatively slender, weakly produced posteriorly. Paramere (Figs 12, 13) lamellar, with an antero-basal bulge and subparallel margins in the middle third, apical third abruptly narrowed to posteriorly directed apex. Distal portion of aedeagus (Figs 14, 15) with large hook-shaped apical dilatation. Female proctiger (Fig. 25) with relatively short thick apical process; subgenital plate, in profile, bearing small point apically. Measurements as in Table 1.

Fifth instar larva (Fig. 28). With following numbers of marginal setae (one side only): head 34-37, forewing pad 88-110, hindwing pad 11-12, caudal plate 98-101. Tarsal arolium oval (Fig. 31). Measurements as in Table 2.

DISTRIBUTION: *T. galii* is widely distributed in the West Palaearctic and Central Asia. We have not seen any specimens from the East Palaearctic where the species probably also occurs. It has been reported from all over the Palaearctic including Japan and Taiwan (Aulmann, 1913; Klimaszewski, 1973; Gegechkori & Loginova, 1990; Ossiannilsson, 1992) but some of the records may concern other species of the *T. galii* complex.

BIOLOGY: *T. galii* is reported to form galls on the buds, stems and leaves of *Galium*, *Rubia* and *Sherardia* spp. We have examined larvae and galls on following

plants: *Galium album*, *G. aparine*, *G. palustre* and *Asperula cynanchica*. The species overwinters as adult. The adults of the new generation appear in June or July. With the available information it is impossible to deduce the number of yearly generations of *T. galii*.

COMMENTS: The type series of *Trioza galii*, originally deposited in the NHMV and now in the MMBC, contains one series from Aachen and one from Ems, leg. von Heyden. The former is homogeneous, but the latter is mixed, including 1 ♂ of *T. galii* and 3 ♂ of *T. velutina*. As Foerster's (1848) description of *T. galii* is not diagnostic, and for stabilising the nomenclature, a lectotype is selected from the series from Aachen. This accords with Flor's (1861a) and Löw's (1882) concept of *T. galii*.

Šulc (1913) admitted that *Trioza galii* in his broad definition, which included *T. distincta* and *T. velutina* as synonyms, exhibited a surprisingly large variation in size and shape of the genal processes, in body and forewing colour, in forewing shape, venation and spinulation as well as in genital morphology. He interpreted differences in the male terminalia mostly as artefacts. For the other characters he suggested that extremes are linked by intermediates. Based on forewing characters he subdivided *T. galii* into four forms for two of which he introduced the names f. *spinogalii* and f. *aspinovelutina*, in addition to *galii* forma typica and f. *velutina*. According to paragraph 45.6.4 of the ICZN (1999) a name introduced before 1961 as "variety" or "form" has to be considered subspecific, unless its author also expressly gave it infrasub-specific rank, or the content of the work unambiguously reveals that the name was proposed for an infrasubspecific entity, in which case it is infrasubspecific. The latter applies to the two names as Šulc mentioned that these narrowly defined forms are linked by intermediates and, thus, implying that they are artificial groupings for convenience rather than diagnosable entities such as subspecies or species. As infrasubspecific names they are not available. Boselli (1930) used the name *Spanioza galii aspinovelutina* for Italian specimens of *T. cocquempoti*, thus misinterpreting Šulc's taxon, which represents *T. galii* judging from Šulc's figures of Austrian specimens. Boselli did not raise the name *spinogalii* to subspecies or species rank, and the name does not become available through Boselli (1930).

The examination of the male holotypes of *T. rubiae* and *T. rubicunda* showed that they are conspecific with *T. galii*, with which they are synonymised.

In *Trioza chenopodii* Reuter the forewing shape is variable as in *T. galii*. Lauterer (1982) demonstrated for the former, that this variation is seasonal, induced by day length. We found no evidence in species of the *T. galii* complex for seasonal differences as in *T. chenopodii*.

Trioza velutina Foerster, stat. rev.

Figs 4, 16-18, 26

Trioza velutina Foerster, 1848: 87. Lectotype ♂, Germany: Rheinland-Pfalz, near Boppard (A. Foerster) (MMBC), here designated, examined.

Psylla velutina; Hardy, 1853: 3876.

Trioza distincta Flor, 1861b: 401. Holotype ♀, Germany: Thüringen, Ruhla, mid June (G. Flor) (MMBC), examined. **Syn. n.**

Trioza galii sensu Šulc, 1910: 16, nec Foerster, 1848; Šulc, 1913: 45. Misidentification.

Trioza galii, Šulc, 1913: 38, p. p.

Trioza galii Foerster f. *spinogalii* Šulc, 1913: 44. Name unavailable, articles 45.6.1 and 45.6.4, ICZN, 1999.

MATERIAL EXAMINED: Material was examined from following countries: Algeria; Armenia; Austria: Niederösterreich, Oberösterreich, Steiermark; Croatia; Czech Republic; France: Ain, Haute-Garonne, Haut-Rhin, Nord, Pyrénées Orientales, Tarn; Germany: Baden-Württemberg, Bayern, Berlin, Brandenburg, Nordrhein-Westfalen, Rheinland-Pfalz (δ lectotype of *Trioza velutina*, paralectotypes 1 δ , 2 φ , Boppard), Sachsen, Thüringen (including φ holotype of *Trioza distincta*); Greece; Hungary; Italy: Alto Adige, Veneto; Kazakhstan; Mongolia; Russia: European part, Altay, Dagestan, Irkutsk District; Slovakia; Spain: Andalusia, Canaries; Switzerland: Aargau, Bern, Basel-Land, Basel-Stadt, Graubünden, Jura, Schaffhausen, Schwyz, Vaud; Turkey: Kars; Turkmenistan; Ukraine; United Kingdom: England, Scotland (BMNH, MHNG, MMBC, MNHN, NHMB, NHMV, SMTD, ZISP, ZMHB). The following material from the Flor collection (EAUT) was examined: 1 δ , no 1090 on yellow label, 1 φ , no 8670 on red label. Both specimens were identified by Flor as *Trioza velutina*. There is no list referring to these particular numbers (O. Kurina, pers. comm.). Their provenience is therefore unknown.

DIAGNOSIS: Adult. Total body length 2.0-2.8 mm. Colour of thorax usually dark brown or almost black with exception of area around wing insertion which is yellowish. Younger specimens with light colour more expanded and dark areas greyish rather than black. Genal processes 0.5-0.9 times as long as vertex along mid-line, subacute apically. Forewing (Fig. 4) relatively short and broad, angular apically; bifurcation of vein M near or slightly distal to line connecting apices of veins Rs and Cu_{1a}. Surface spinules present in all cells of forewing, forming more or less expanded fields. Hindwing three quarters of forewing length. Male proctiger (Fig. 16) relatively slender, weakly produced posteriorly. Paramere (Fig. 17) slender, lamellar, evenly tapering to apex, blunt apically. Distal portion of aedeagus (Fig. 18) with relatively short apical hook. Female proctiger (Fig. 26) with relatively short, massive apical process, pointed apically; subgenital plate, in profile, bearing small point apically. Measurements as in Table 1.

Fifth instar larva unknown.

DISTRIBUTION: Probably widely distributed in the Palaearctic region. There are no reliable literature records as the species has been previously confused with *T. galii*.

BIOLOGY: Unknown, probably also on *Galium* spp. on which adults have been collected.

COMMENTS: For the validity of the name f. *spinogalii* Šulc see comments on *T. galii*.

***Trioza velutina* Foerster var. *thoracica* Flor, nomen dubium**

Trioza velutina Foerster var. *thoracica* Flor, 1861a: 514. Holotype φ , France: Bouche du Rhône, Gémenos near Marseille (G. Flor), not examined, probably lost (Šulc, 1913: 44).

COMMENTS: Flor (1861a) described *Trioza velutina* var. *thoracica* for a single φ from Southern France. According to paragraph 45.6.4 of the ICZN (1999) the name *thoracica* has to be regarded as subspecific and as such becomes available. Flor's description is not diagnostic. Furthermore the holotype could not be traced in the collections of the EAUT (O. Kurina, pers. comm.) and NHMV (H. Zettel, pers. comm.) and appears to be lost (Šulc, 1913: 44). For this reason we regard *thoracica* as nomen dubium.

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